PROJECT FACT SHEET

CONTRACT TITLE: Multi-Phase Fluid Simulator for Underbalanced Drilling

ID NUMBER: ACTI-105

B & R CODE: AB05

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CONTRACT PERFORMANCE PERIOD:
03/10/1995 to 04/01/1996

PROGRAM: Supporting Research
RESEARCH AREA: Partnership

FUNDING (1000'S)	DOE	CONTRACTOR	TOTAL
PRIOR FISCAL YRS	0	0	0
FISCAL YR 1996	0	0	0
FUTURE FUNDS	0	0	0
TOTAL EST'D FUNDS	0	0	0

OBJECTIVE: Develop a multi-dimensional, 3 phase, dynamic code for modeling the flow of compressible fluids and cuttings in a drilling fluid circulation system.

METRICS/PERFORMANCE:

Products developed: An early prototype simulator has been tested and verified against a Penn State Hydrodynamic Model for simple air drilling systems.

Industry input from industrial advisory panel has been forthcoming and a somewhat modified technical objective has been formulated for their consideration.

PROJECT DESCRIPTION:

Background: The domestic drilling industry is searching for ways to reduce petroleum drilling costs and improve well productivity. By reducing the bottom-hole-pressure during drilling, penetration rates are increased and a positive flow from the producing formations is established that protects them from infiltration of drill cuttings and fluids. Underbalanced drilling reduces the pressure on the drilled formations by using low density drilling fluids such as air, mists, foams, or aerated drilling muds. Use of these fluids is gaining increasing acceptance in the petroleum industry because drilling rate increases of 50 to 100% are frequently achieved. Oil and gas producing rates are increased when drill fluid invasion is reduced. Underbalanced drilling is particularly useful for drilling infill wells through depleted zones and for wells with long horizontal sections.

The inability to predict wellbore pressures accurately and assure efficient cuttings transport limits the use of compressible drilling fluids. There are analytical and empirical methods to calculate pressure drop, particle slip and cuttings bed velocities in many multi-phase flow regimes. The methods are presently accurate over very limited phase ratios, flow geometries, rheologies, and flow parameters. The implicit nature of these calculations for compressible fluids challenge analytical methods. Simplifications that require averaging of flow properties and velocities or that do not calculate temperatures based on heat transfer will be inaccurate. A much more comprehensive simulator than is presently available is needed to accurately model (1) flow of mixed or complex compressible fluids, (2) complex flow geometries, (3) high temperature or deep drilling, and (4) in real time.

Work to be performed: This project will develop a flow simulator that will model fluid flow through an underbalanced drilling system. The simulator will be coupled to a wellbore heat transfer code to simulate temperature and pressure. The simulator will allow particle size and bubble size distributions to be modeled. Multidimensional simulations will be performed to allow accurate simulation of complex flow behavior. Code results will be verified against laboratory and drilling data furnished by the participants and compared to hydraulic models developed by service companies, universities, and well operators.

PROJECT STATUS:

Current Work: This project did not receive any FY96 authorization. The project operated at a reduced effort through 04/01/96 on FY95 carryover. All work except closeout activities has been suspended.

Scheduled Milestones:

Complete initial prototype computational code	06/96
Complete verification of initial prototype code	01/97
Develop performance specification for drilling program simulator	04/97
Complete development of comprehensive prototype code	08/97
Develop performance specification for real time simulator	08/97

Accomplishments: A 3-D multi-component fluid dynamic code (CFDLIB from T-3) has been evaluated, selected, and prepared to serve as the platform for the fluid simulator. An Industry Advisor Panel has been organized and industrial cost share drilling R&D contract has been placed with Maurer Engineering. A University research contract has been placed with Penn State.